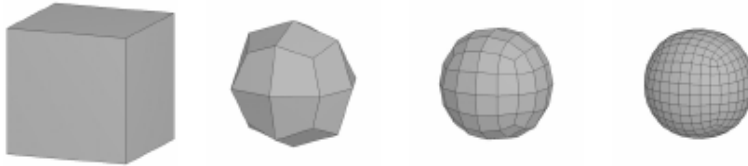


# Subdivision – curves and surfaces

**Special lecture & tutorial:** winter term 2019/20 (details in KUSSS)

In this lecture we will learn about the mathematics behind computer animation. What's the underlying principle? Why is it so popular? How does it work?

Subdivision refers to a family of methods, which refine a mesh of polygons (triangles or quadrilaterals) to obtain a smooth shape.



We will study the basics of subdivision, well-known construction schemes and general concepts for both curves and surfaces. Some of the questions we will focus on are:

- How smooth can we make the curves and surfaces?
- Can we change the shape “locally”?
- Can we create special shapes?
- When do the methods fail?

**What we learn:** Corner cutting, B-splines, box splines, special schemes (4-point, Doo-Sabin, Catmull-Clark, Loop, butterfly), mathematical properties (characterization, convergence, continuity, support, polynomial reproduction, pointwise evaluation, geometric sensitivity, . . .), some implementations

**What we need:** Basic linear algebra (matrices, vectors, eigenvalues and eigenvectors), basic calculus (differentiation), basic programming skills

**Literature:**

- Analysis and Design of Univariate Subdivision Schemes, Sabin (2010)
- Mathematics of Subdivision Surfaces, Andersson & Stewart (2010)
- Subdivision Methods for Geometric Design, Warren & Weimer (2002)
- Subdivision Surfaces, Peters & Reif (2008)